

(12) UK Patent Application (19) GB (11) 2 335 687 (13) A

(43) Date of A Publication 29.09.1999

(21) Application No 9906813.2

(22) Date of Filing 25.03.1999

(30) Priority Data

(31) 9806274	(32) 25.03.1998	(33) GB
(31) 9812456	(32) 10.06.1998	
(31) 9818553	(32) 26.08.1998	
(31) 9821484	(32) 03.10.1998	
(31) 9824528	(32) 10.11.1998	
(31) 9819013	(32) 01.09.1998	

(51) INT CL⁶

E21B 37/00 37/02 43/08

(52) UK CL (Edition Q)

E1F FJF FLC

(56) Documents Cited

US 5330003 A US 4515212 A

(58) Field of Search

UK CL (Edition Q) E1F FJF FLC

INT CL⁶ E21B 37/00 37/02 43/02 43/08

Online: WPI, EPDOC

(71) Applicant(s)

Specialised Petroleum Services Limited
(Incorporated in the United Kingdom)
Peregrine Road, Westhill Business Park, Westhill,
ABERDEEN, AB32 6JL, United Kingdom

(74) Agent and/or Address for Service

Kennedy & Co
Station House, 34 St Enoch Square, GLASGOW,
G1 4DF, United Kingdom

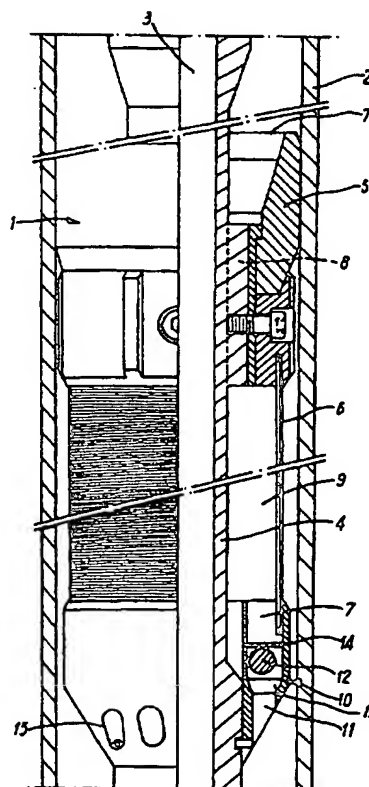
(72) Inventor(s)

Mark Carmichael
Paul David Howlett

(54) Abstract Title

Apparatus for catching debris in a wellbore

(57) A down-hole tool (1) for collecting debris particles in a well bore (2) comprises a body (4) connectable to a work string, diversion means (5) for diverting well fluid through the body, and a filtration means (6) for filtering debris particles from at least some of the fluid. The diversion means may comprise a barrier to permit negligible by-pass of fluid outside the tool body and flow paths (7,8,9,10) to direct fluid to the filtration means. One-way valves (12,13) may be included to allow fluid flow in a single direction. The barrier may be formed as a separate component and may be resilient and radially compressed by the well bore. The tool may comprise cleaning members to wipe the well bore tubular. The filtration means may comprise a wire screen, and may include a plurality of filters of differing permeability. The tool may comprise a trap (9) for the collection of debris particles, and may also include an emergency by-pass which allows fluid to bypass the filter in predetermined conditions.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

BEST AVAILABLE COPY

GB 2 335 687 A

1/8

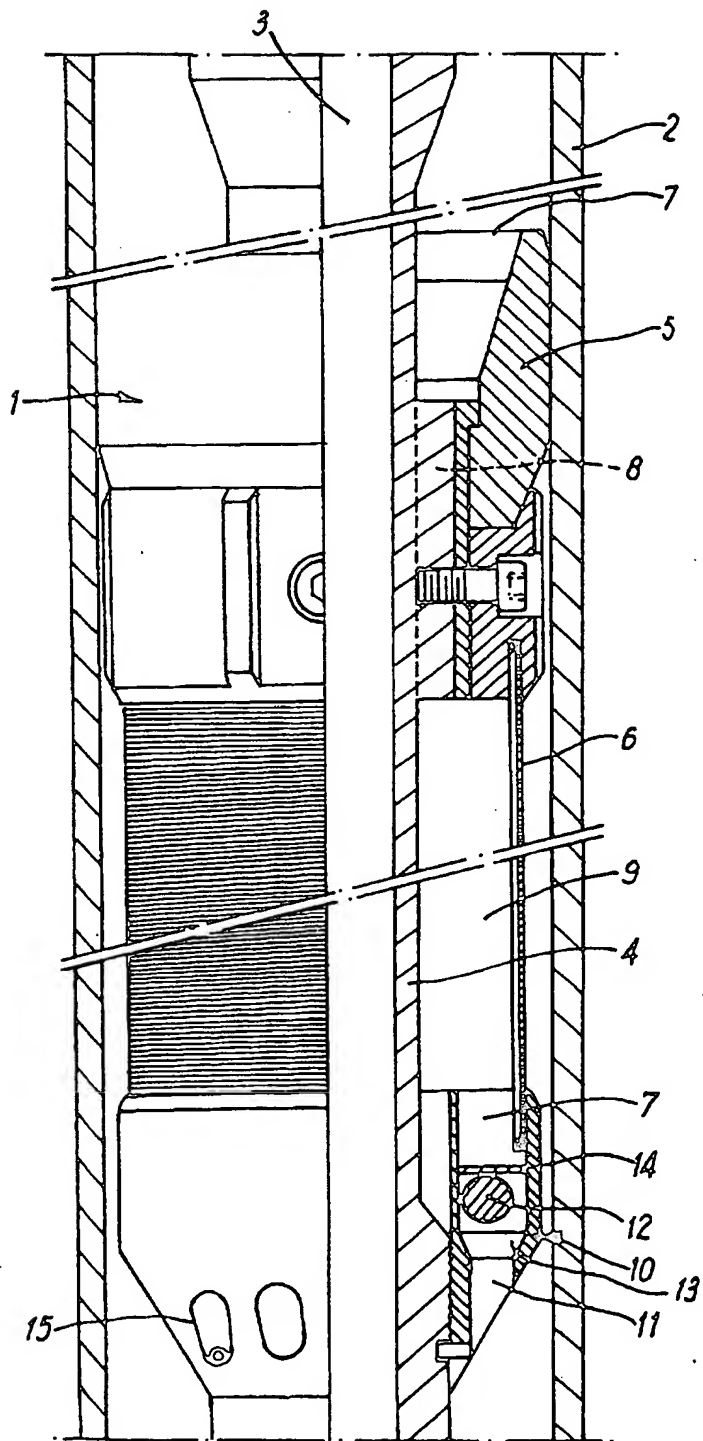


FIG. II

2/8

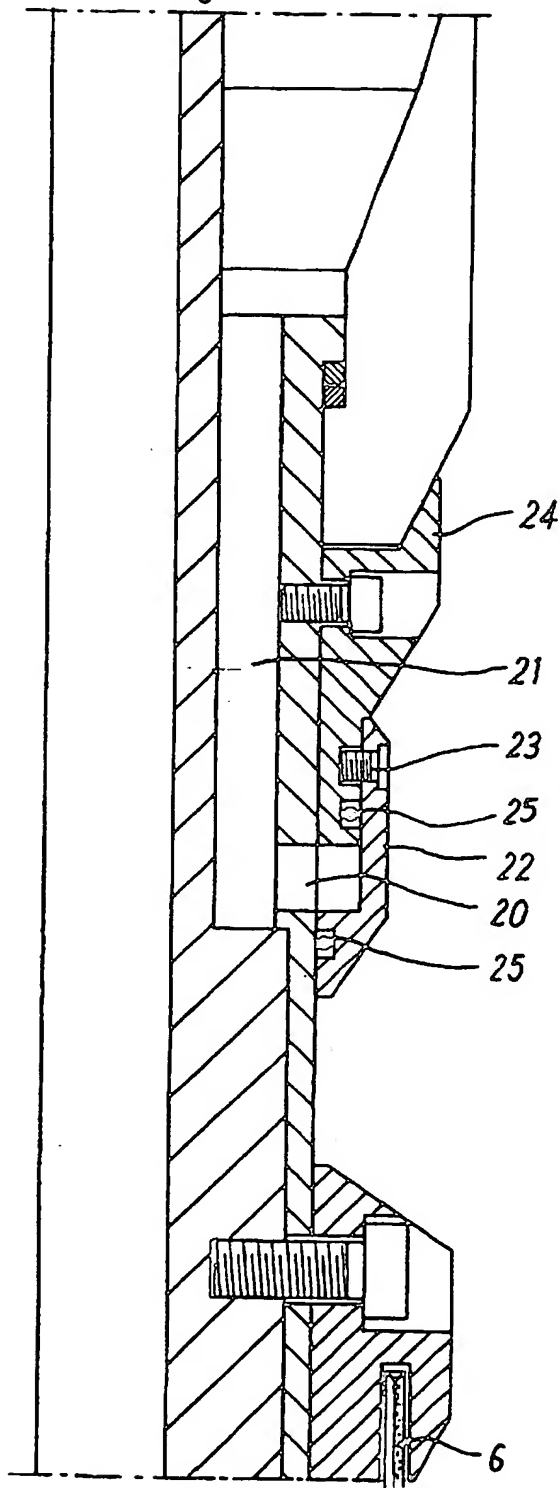
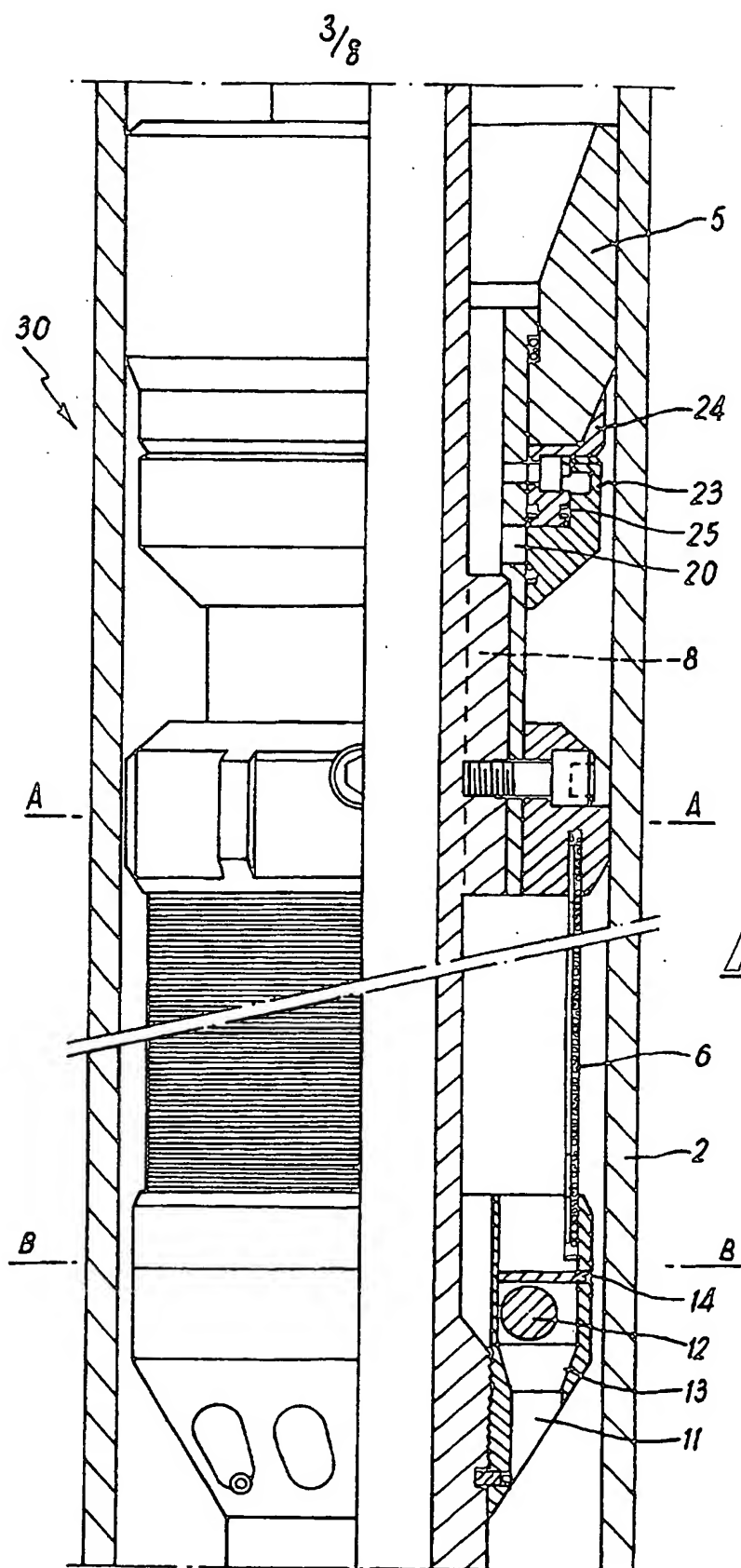


FIG. 2



FILE 3

4/8

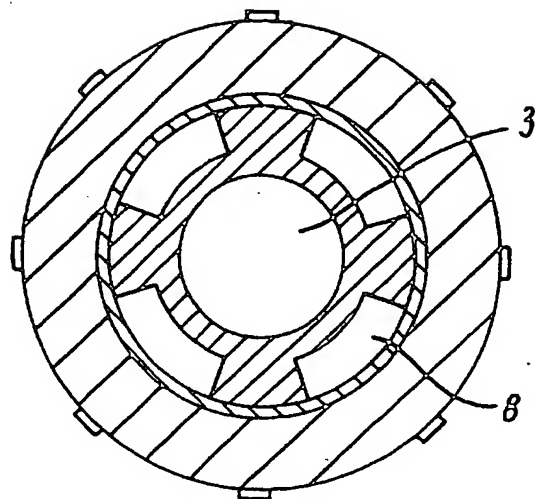


FIG. 4A

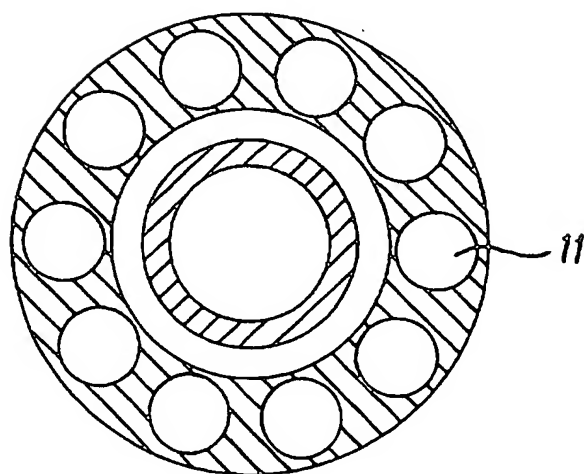


FIG. 4B

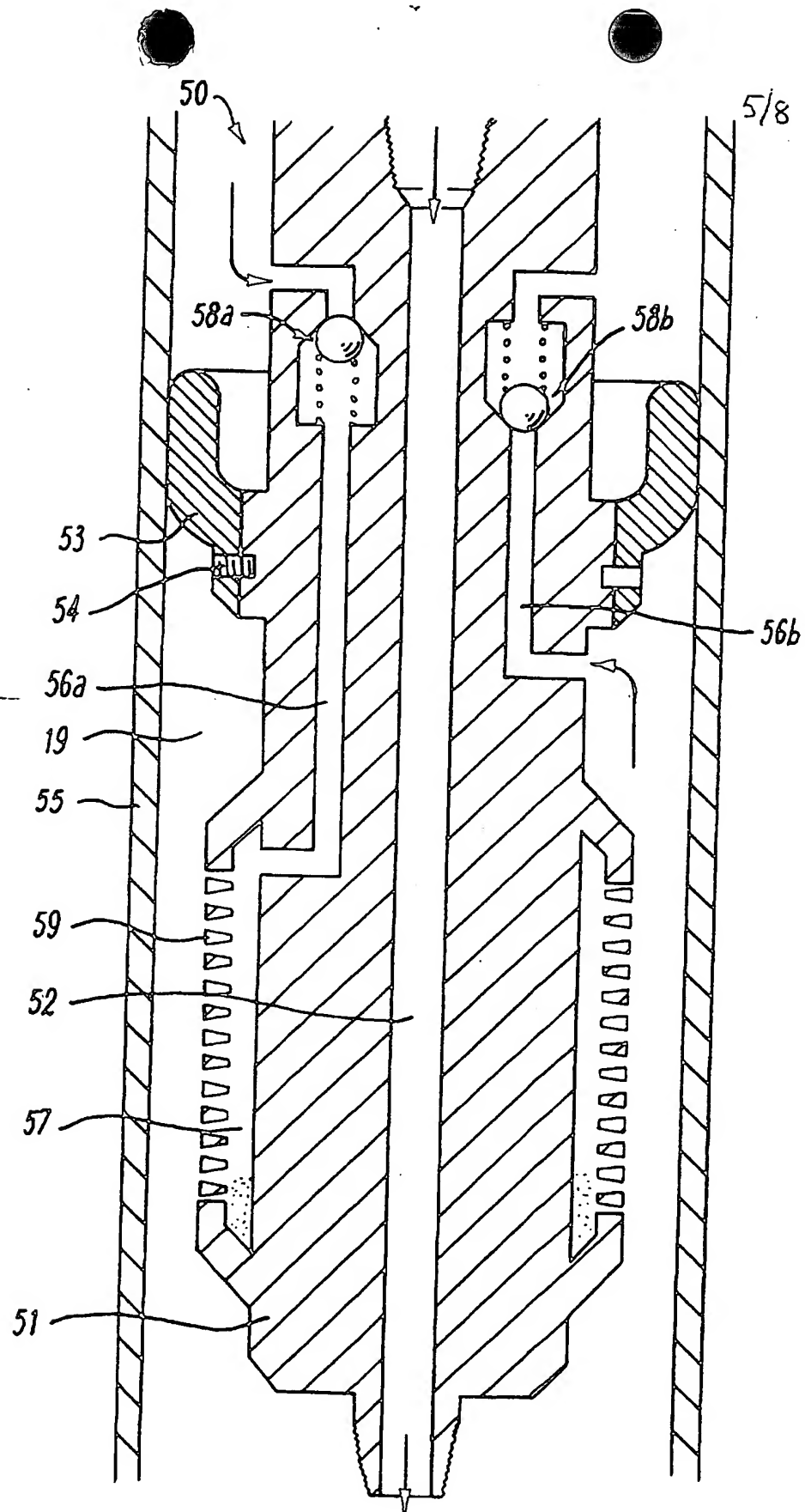


FIG. 5

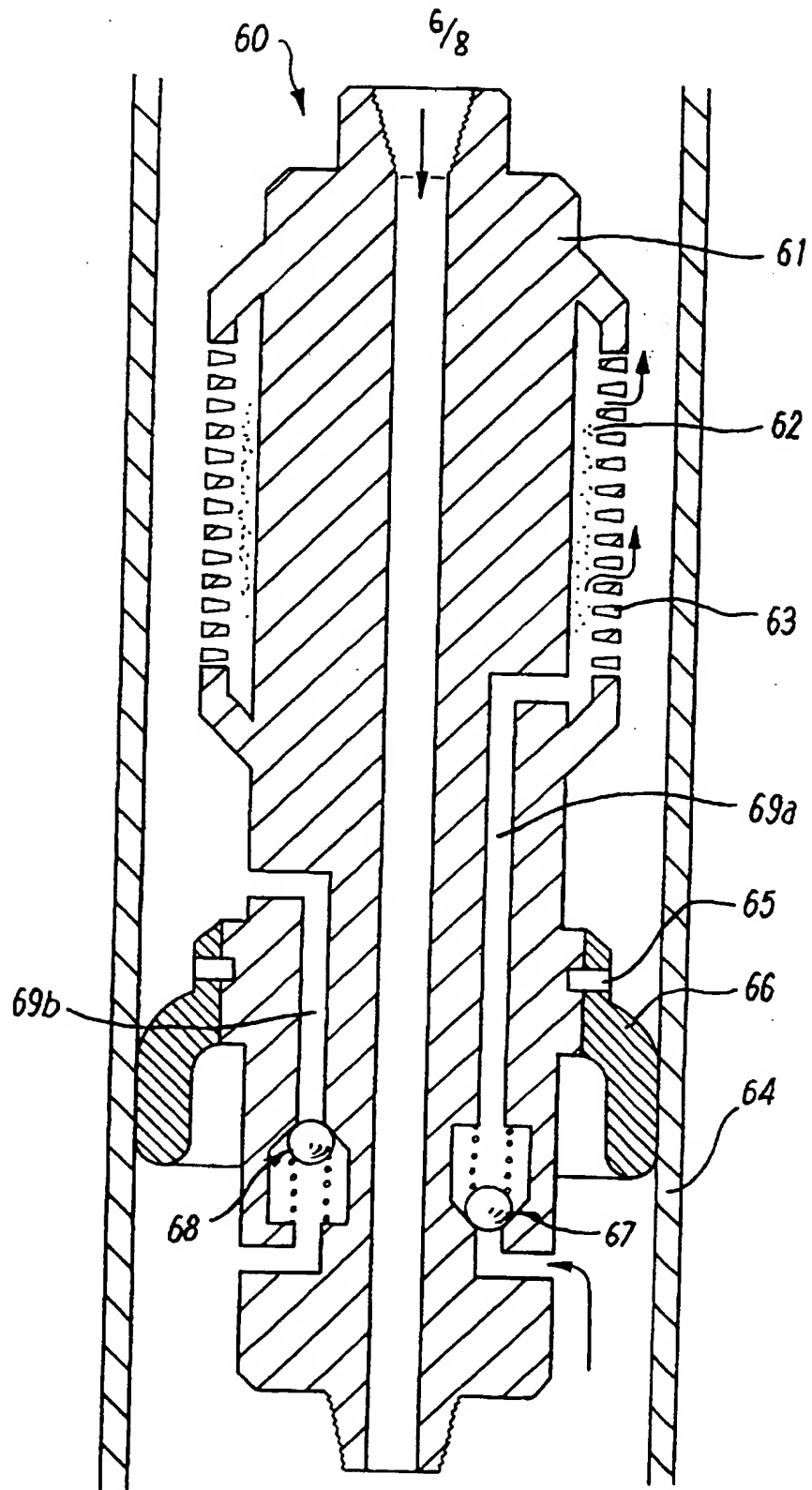


FIG. 6

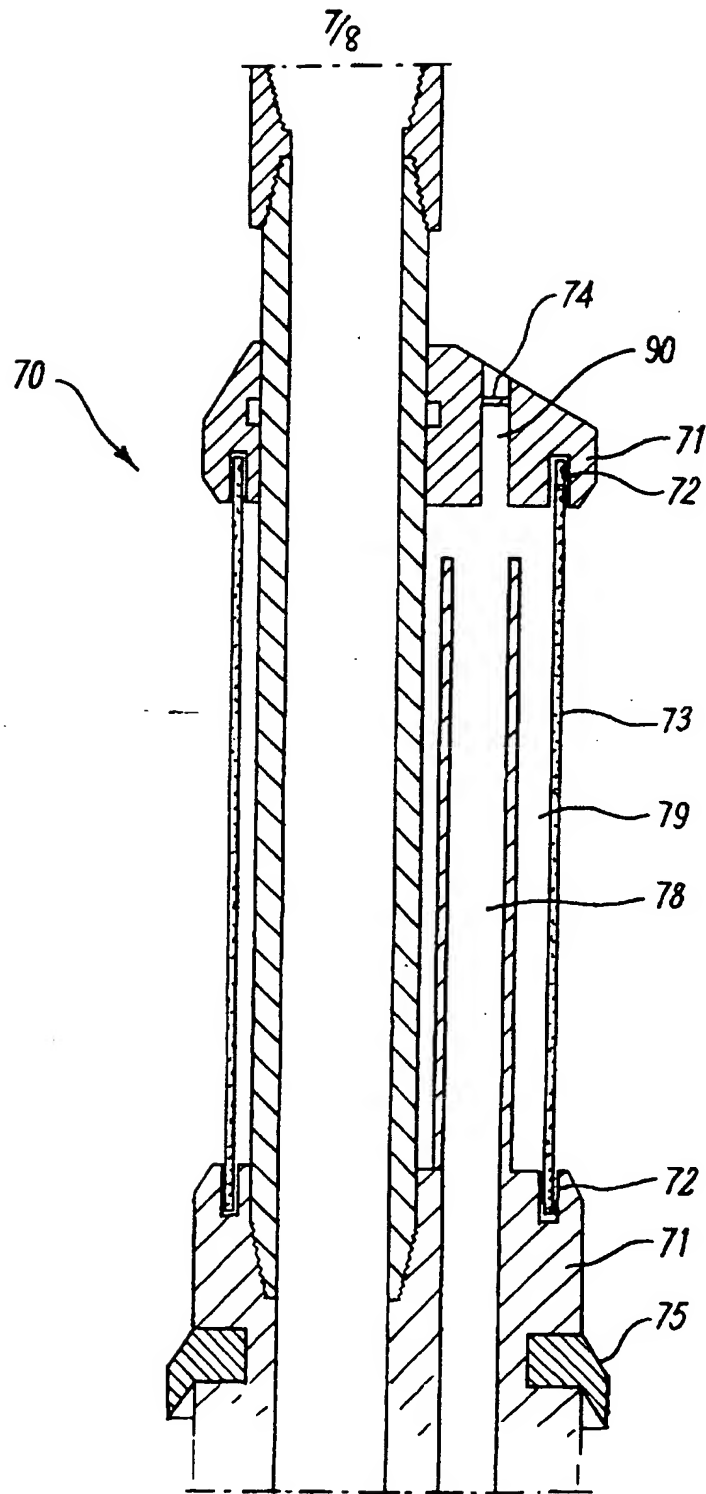


FIG. 7

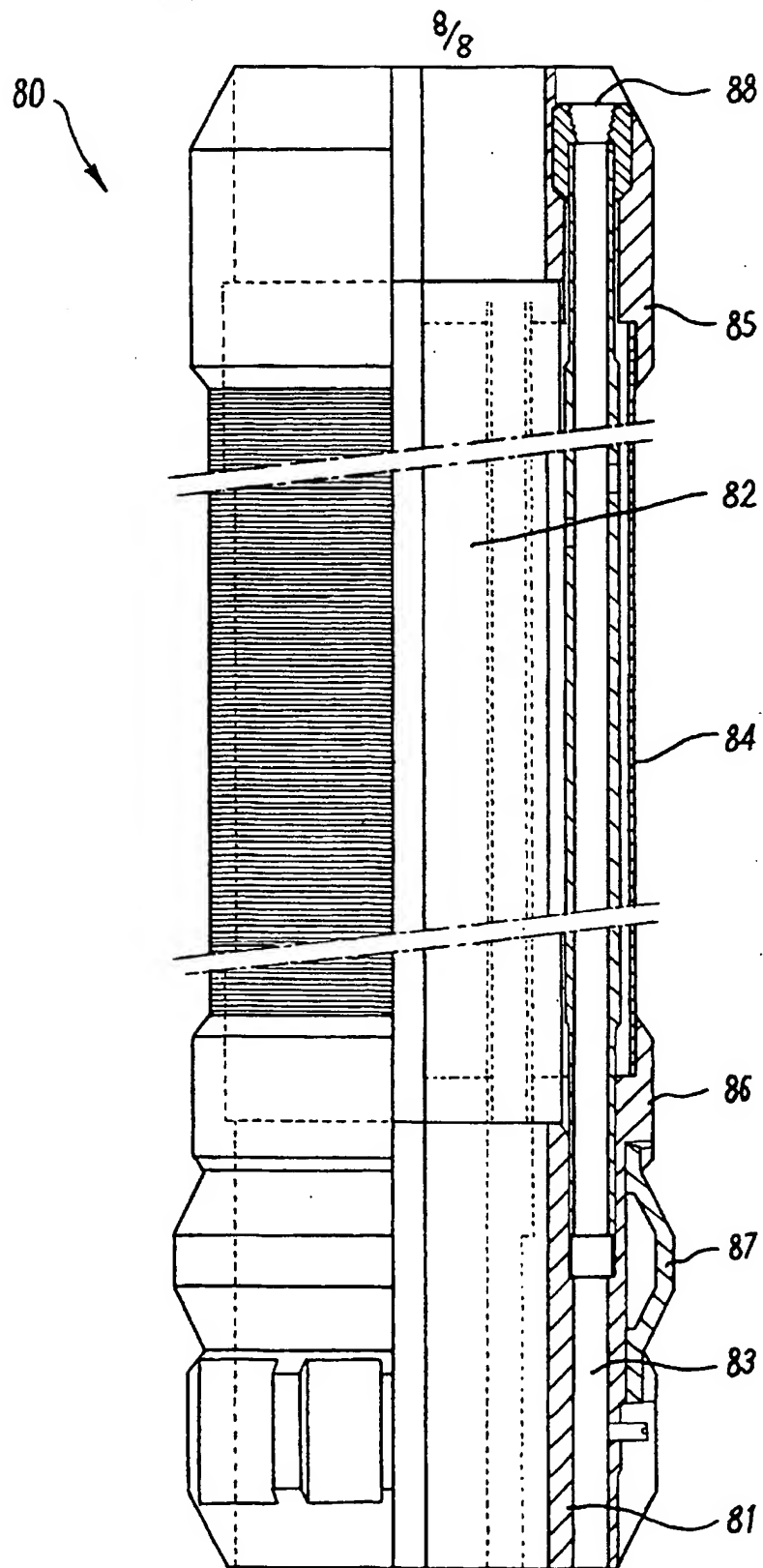


FIG 8

1 APPARATUS FOR CATCHING DEBRIS IN A WELL-BORE

2

3 The present invention relates to apparatus for cleaning
4 the interior bore of well bore tubulars, such as is found
5 in the oil and gas production industries. A distinctive
6 aspect of the invention lies in its provision of a means
7 for filtering or screening well fluid while down-hole.

8

9 It is considered desirable when drilling for oil or gas
10 to maintain a clean interior in the casing or liner of
11 the drilling well. For this purpose, well cleaning
12 equipment is well known and comes in a variety of
13 different forms, including casing scrapers, brushes and
14 circulation tools. Such equipment is used to free the
15 well tubing from debris particles such as, cement lumps,
16 rocks, congealed mud, and so on.

17

18 Indeed well clean-up apparatus is used in an attempt to
19 clean the casing or other well tubing of even smaller
20 debris particles such as oxidation lumps, metal debris,
21 scale, slivers, shavings and burrs for example.

22

1 It is now common practice to run dedicated well cleaning
2 apparatus after cementing the liner and prior to
3 completion. Tools have also been provided in the art
4 which are intended to perform a cleaning operation in
5 wellbore completions.

6

7 However, in the present invention it is recognised that
8 during the extraction of known cleanup tools from the
9 well, additional debris can be dislodged, such as from
10 the wall of the casing, thereby negating much of the
11 cleaning work already performed. In fact, the
12 dislodgement of debris or particles during the extraction
13 of the tool can render futile the processes of filtering
14 and fine-screening that may have gone before. This
15 problem is particularly prevalent as such cleanup tools,
16 known to the art, typically have their cleaning members
17 biased outwardly to ensure adequate pressure of the
18 cleaning members on the walls of the casing or liner.
19 While this is of assistance during the cleaning process,
20 it has been a disadvantage during the extraction of the
21 tool from the well.

22

23 It is also recognised in the present invention that tools
24 suited to the cleaning of well tubulars are not generally
25 also equipped to clean the well fluid. It is usual
26 therefore that debris dislodged from the casing or liner
27 walls is not then fully removed from the well by
28 circulation. Rather, the debris may remain suspended in
29 well fluid down-hole, having detrimental effects during
30 subsequent production stages.

31

32 An object of the present invention is to obviate or at
33 least mitigate this problem associated with known clean
34 up tools and their use.

1 A further object of the present invention is to provide
2 apparatus suitable for providing a means of trapping and
3 collecting debris in a well-bore.

4
5 In the art there are tools commonly referred to as junk
6 catchers. These tools are of varying design; some being
7 suitable for running on a pipe string, other on coiled
8 tubing, and yet others on wireline. A notable aspect of
9 such tools, however, is that while they invariably
10 provide a cage or some other catchment area for
11 collecting debris or the like down-hole, they are not
12 adapted to filter properly the well fluid. More
13 particularly, junk catchers and or junk subs known in the
14 art have not been arranged to encourage the circulation
15 of well fluid through a filter in a manner that is pro-
16 actively designed to screen debris or other particles out
17 of the fluid.

18
19 According to the present invention there is provided a
20 down-hole tool for collecting loose debris particles in a
21 well bore, the tool comprising a body connectable in a
22 work string, diversion means for diverting well fluid
23 passing the tool through the tool body, and a filtration
24 means for filtering debris particles from at least some
25 of the well fluid.

26
27 The work string may be a pipe string, coiled tubing or a
28 wireline.

29
30 It should be understood that the diversion means may be
31 formed wholly or partially integral with the tool body.
32 Preferably the diversion means comprises a barrier having
33 an outer diameter that corresponds with the internal
34 diameter of an adjacent tubular in the well bore to the

1 extent that there is negligible fluid by-pass outside the
2 tool body, and one or more flow paths that direct fluid
3 passing through the tool body to the filtration means.
4 It is possible to design the tool such that it filters
5 the well fluid when the fluid moves in only one direction
6 relative to the tool, that is in either an up-hole
7 direction or a down-hole direction. This may be achieved
8 by providing a plurality of flow paths in the tool body,
9 the flow paths being associated with respective one-way
10 valves whereby when the fluid passes through the tool
11 body in a first relative direction it does so through a
12 first set of the flow paths having one way valves that so
13 permit, and when the fluid passes through the tool body
14 in a second and opposite relative direction it does so
15 through a second set of the flow paths having one way
16 valves that so permit, but wherein only one of the first
17 and second set of flow paths is adapted to divert the
18 fluid through the filtration means.

19

20 The valve means may be balls moveable within respective
21 flow paths under the influence of fluid flow or pressure,
22 wherein the balls are sized to land in sealing engagement
23 with a restricted area in the flow paths for blocking
24 further passage of fluid in a particular direction in the
25 respective flow path.

26

27 The barrier is preferably formed as a separate component
28 from the tool body. One advantage of this is that the
29 barrier may be connectable to the body by bearings,
30 thereby permitting relative rotation between the tool
31 body and the barrier. Accordingly the barrier need not
32 rotate against the well bore tubular, enabling improved
33 longevity through less wear. Additionally, the barrier

1 may be replaced, if necessary, without the requirement of,
2 replacing the entire tool body.

3

4 It may be appreciated that these advantages are most
5 applicable where the barrier contacts the well bore
6 tubular. Preferably, the barrier is a resilient member
7 which is radially compressed by the well bore tubular in
8 use and which is adapted to wipe the well bore tubular as
9 the tool moves up or down the well bore.

10

11 There may be more than one barrier, and in a preferred
12 embodiment, a barrier in the form of a resilient wiping
13 member may be provided toward each end of the tool.

14

15 Where the tool is adapted for connection to a pipe string
16 or coiled tubing, the tool body is preferably provided
17 with an internal bore adapted to communicate with a
18 circulation path in the work string.

19

20 The filtration means may be a wire screen sized to
21 prevent particles of a predetermined size from passing
22 therethrough. It will be appreciated however that many
23 different types of filtration apparatus may be used,
24 including permeable textiles, holed tubes or cages, and
25 so on. The filtration means need not be limited to any
26 one particular type of screen or filter, but may rather
27 comprise of a plurality of filters in series; the filters
28 being potentially of varying type and permeability.

29

30 The tool may also act as a collector or trap for debris
31 and the like. For example, a trap may be provided on the
32 up-stream side of the filter means for storing the
33 filtered debris.

34

1 Optionally, a separate filter may be provided for each
2 filtered flow path, and the flow paths on the up-stream
3 side of the filter means may act as the traps for
4 collecting the debris particles.

5

6 Preferably the tool comprises an emergency by-pass means,
7 whereby well fluid is enabled to by-pass the filter
8 means, for example when the filter becomes blocked or
9 clogged. The emergency by-pass means may comprise of
10 means for displacing the barrier relative to the tool
11 body to a position where it no longer diverts
12 substantially all of the fluid passing the tool through
13 the tool body. Alternatively, the tool body may include
14 radial outlets communicating with the one or more flow
15 paths, the outlets being maintained in a closed state by
16 an obturating member in normal use, but being openable by
17 movement of the obturating member to create the emergency
18 bypass flow path. Typically, the obturating member may be
19 held in an obturating position by one or more shear pins,
20 wherein said shear pins are adapted to shear or otherwise
21 fail under a given load, resulting from an increase in
22 pressure due to blockage of the filter means.

23

24 The tool requires the relative movement of the well fluid
25 in order to perform its function as a filter. This may be
26 achieved by the movement of the tool in a down-hole or an
27 up-hole direction or by circulating fluid in the well
28 bore such that it has a net movement relative to the
29 tool, regardless of whether the tool is being moved or
30 held stationary.

31

32 In order to provide a better understanding of the
33 invention, embodiments thereof will now be described, by

1 way of example only, and with reference to the
2 accompanying drawings, in which:

3

4 Figure 1 is a half sectional elevation of a first
5 embodiment of a tool in accordance with the
6 invention;

7

8 Figure 2 is a half sectional elevation of a portion
9 of a tool similar to the tool of Figure 1, but
10 incorporating a further improvement;

11

12 Figure 3 is a half sectional elevation of a tool
13 incorporating the improvement of Figure 2;

14

15 Figures 4a and 4b are cross sections through the
16 lines A-A and B-B respectively of the tool of Figure
17 3;

18

19 Figure 5 is a full sectional elevation of an
20 alternative embodiment of tool;

21

22 Figure 6 illustrates, again in sectional elevation,
23 a tool of similar design to that depicted in Figure
24 5, but with an arrangement suited to filtering the
25 well fluid on running in the well; and

26

27 Figures 7 and 8 also show sectional elevations of
28 two further embodiments of tools in accordance with
29 the invention, and both being suitable for use when
30 putting in to a well-bore such as during well
31 completion.

32

33

1 In Figure 1 there is depicted a tool 1 located in a well
2 bore tubular 2, such as a casing. The tool 1 is intended
3 to be run on a pipe string and is provided with an
4 internal bore 3 defined by the internal diameter of a
5 central mandrel 4 running the full length of the tool 1.
6 The bore 3 offers a circulation path for well fluid
7 flowing up or down the pipe string.

8

9 The tool body is provided by the central mandrel 4 and
10 further components built up around the mandrel 4. These
11 components provide a housing or attachment means for a
12 barrier 5 and a filter 6.

13

14 Flow paths on the outer side of the mandrel 4 for well
15 fluid are defined by the tool body, barrier 5 and filter
16 6. It should be noted however that the flow paths of
17 well fluid differ depending on which direction the fluid
18 travels relative to the tool 1.

19

20 The tool 1 is designed to filter the well fluid when the
21 well fluid on the outer side of the mandrel 4 moves
22 (relative to the tool 1) in a down-hole direction. This
23 will occur when fluid is pumped down the annulus between
24 the pipe string and the casing 2, but more typically when
25 the tool 1 is pulled out of the hole.

26

27 As this occurs, the well fluid travels through one or
28 more flow paths defined by the inlet 7 in the barrier 5,
29 a plurality of bores 8 provided in an enlarged area of
30 the mandrel 4, an annular chamber 9, through the filter 6
31 and finally past the outer circumference of a lower
32 retaining assembly 10.

33

1 Thus, it may be perceived that well fluid passing the
2 tool in this direction will be filtered by the filter 6.
3 Notably, the fluid can not pass through channels 11
4 formed in the lower retaining assembly 10 in a down-hole
5 direction by reason of a one-way valve located in each
6 said channel 11.

7
8 In this example embodiment, each valve comprises of a
9 ball 12 that co-operates with a restricted area or
10 landing 13 in the channels 11. Fluid flowing in a
11 relative down-hole direction forces the balls 12 down on
12 to their respective landing 13, the balls and landings
13 being sized to allow for their sealing engagement.

14
15 Each ball 12 is moveable in its respective flow channel
16 11 under the influence of fluid flow or pressure.
17 However, upward or up-hole movement of the balls 12 is
18 limited by a bar 14 provided in each channel 11. The bars
19 14 prevent further upward movement of the balls 12 but do
20 not restrict the flow of fluid through the channels 11
21 even when the balls 12 are pressed up against them.

22
23 The valve means need not be provided as balls and rests.
24 The invention envisages the use of a one way valve system
25 and forms of such are plentiful and will be well known to
26 those skilled in the art. Where moveable balls are used,
27 it would be preferable to provide them with relatively
28 low specific gravity to ensure that they are suitably
29 influenced by fluid flow.

30
31 Thus, when the fluid travels in an up-hole direction
32 relative to the tool 1, such as during normal circulation
33 or when the tool is run in the well bore, the one or more
34 flow paths of the fluid are defined by the channels 11

1 commencing at their inlets 15, the chamber 9, bores 8 and
2 finally out the opening 7 in the barrier 5. This
3 relatively unrestricted flow path provides little
4 hindrance to the running of the tool, having ample bypass
5 area and not requiring the fluid to pass through the
6 filter 6.

7

8 In the example tool depicted in Figure 1, the barrier 5
9 comprises a resilient swab cup, with a concave-up
10 orientation. The outer circumference of the cup 5 wipes
11 the casing 2 as the tool 1 moves in the well bore. The
12 cup is designed to access remote or uneven locations in
13 the casing 2, such as joints in the casing string or
14 other areas where cavities on irregular dimensioning may
15 occur. The cup 5 is particularly suitable for wiping any
16 grease or other debris particles off the casing and into
17 suspension in the well fluid, thereby enabling it to be
18 filtered by the tool, especially when the tool 1 is
19 pulled out of the hole.

20

21 The profile of the cup 5 also serves as a diversion means
22 by diverting well fluid travelling in a relative down-
23 hole direction into the opening 7 and down through the
24 one or more flow paths.

25

26 The barrier 5 need not be keyed to the tool body allowing
27 it have minimal rotational movement even when the work
28 string is rotated. In the tool 1, the cup 5 is mounted
29 on bearings 16 for this reason, which allows for its
30 reduced wear and longer life.

31

32 The filter 6 is shown as a wire wrap filter, although
33 gauze or any other suitable filtration medium known to
34 persons skilled in the art may be employed.

1 The chamber 9 acts as a trap in which the filtered debris
2 may collect.

3

4 An improvement over the novel tool discussed above lies
5 in the provision of an emergency bypass. This may be
6 required for example when a tool is required to clean a
7 particularly dirty well and there is a build up of debris
8 in the tool to such extent that insufficient flow can
9 pass through the filter means. In such event it would be
10 advantageous to provide a means for allowing fluid to
11 bypass at least the filter and associated debris trap
12 when the tool is being pulled out of the hole or during
13 circulation.

14

15 One manner of achieving this emergency by-pass in
16 relation to a tool of similar design to that depicted in
17 Figure 1 involves the displacement of the barrier means
18 to a position relative to the tool where fluid may by-
19 pass around the outside of the barrier means. An
20 embodiment incorporating this facility is discussed with
21 reference to Figure 5. Another option is to provide a
22 rupture disc or the like in the barrier means which opens
23 when subjected to a predetermined pressure.

24

25 A further option is shown in the example embodiment
26 illustrated in Figure 2, wherein a radial outlet 20
27 communicates with a flow path 21. In normal use the
28 outlet 20 is closed by an obturating sleeve 22 held in
29 place by a screw or other mechanical fastener 23 that
30 connects with the barrier retaining assembly 24. Seals 25
31 maintain the integrity of the closed outlet 20. However,
32 in the event that there is a build up of pressure in the
33 flow path 21 resulting from a blockage or the like, the
34 mechanical fastener 23 breaks allowing for the giving way

1 of the obturating sleeve 22 and the passage of fluid out
2 of the outlet 20, thereby by-passing the filter 6 and
3 blockage further down in the tool.

4

5 Figures 3 and 4 show, in sectional elevation and cross
6 section respectively, a tool 30 incorporating the
7 improvement discussed above with reference to Figure 2.

8 Like parts in the afore-described tools are given
9 identical reference numbers for ease of comparison of the
10 Figures.

11

12 The tool 30 would suitably be located at or near the
13 bottom of a work string to ensure that it was positioned
14 to catch all or at least the majority of debris or
15 particles that might be dislodged from the casing during
16 the extraction of the work string. However, it is
17 envisaged in the invention that a tool incorporating the
18 invention may be run in conjunction with other tools or
19 subs so as to provide a synergy. For example, a tool in
20 accordance with the present invention may be run with a
21 junk catcher or the like located below it on a work
22 string. A further example would be to run a tool
23 incorporating the invention with other well clean-up
24 tools such as casing scrapers, brush tools and the like
25 known to the art from time to time. Similarly, a ball-
26 drop sub may be run in a work string above a tool
27 described herein to allow for communication of fluid
28 between the work string and the annulus between the work
29 string and the well bore tubular.

30

31 Turning now to Figure 5, a further embodiment of a tool
32 adapted to filter well fluid while down-hole is depicted.
33 The tool 50 has a body 51 defining an axial circulation
34 path 52 internally therein. The tool 50 is attachable in

1 a work string through the provision of threaded
2 connectors at its respective axial ends.

3

4 Attached to the periphery of the body 51 is a resilient
5 cup 53 positioned in a concave up orientation. The cup 53
6 sealingly engages the internal surface of the casing wall
7 55, wiping the casing as the tool 50 moves. the cup 53
8 further provides a barrier which diverts fluid passing
9 the tool 50 into the flow paths 56 formed in the walls of
10 the body 51. The flow paths 56 provide a passage for the
11 flow of fluid past and generally outside the tool 20,
12 creating a by-pass around the cup 23.

13

14 The flow path 56a allows well fluid to travel in a down-
15 hole direction relative to the tool 50. Positioned in the
16 flow path 56a is a check valve 58a having a ball that is
17 biased against a seat or restricted area to close the
18 valve. However when the tool 50 is being retrieved or
19 picked up, fluid pressure acts on the upper surface of
20 the ball so as to open the valve 58a and allow for the
21 passage of fluid through the flow path 56a to the chamber
22 57. The chamber 57 provides a trap or collection
23 reservoir for debris or other particles that are unable
24 to pass through a filter 59 provided at the outlet of the
25 passage 56a.

26

27 A second flow path or set of flow paths 56b is also
28 formed in the body 51. These provide a path for the
29 passage of fluid past the tool 50 in a relative up-hole
30 direction. The flow path 56b is also provided with a
31 check valve 58b, but one which is adapted to open in
32 response to upward fluid pressure, such as would be
33 expected when the tool is run in a down-hole direction in
34 the well bore. The ball in the valve 58b may rest on its

1 seat under gravity or be biased downward by a spring or
2 the like.

3

4 The embodiment of the tool 50 incorporates an emergency
5 by-pass means to cater for a situation where one or more
6 of the check valves become jammed or clogged in a closed
7 position or the flow paths become other wise blocked,
8 such as in the chamber 57 in the flow path 56a. This is
9 so because, if necessary, fluid may be pumped up past the
10 cup barrier 53, given the resilient properties of the cup
11 walls. Moreover, fluid may be pumped down hole relative
12 to the tool so as to pressure up above the cup 53 until
13 the shear screw 54 shears and allows the cup to move down
14 relative to the body 51 until it rests in the inset 19.

15

16 The above described tools may also be provided with a
17 barrier or other wiping means at the lower end of the
18 tools. This may be advantageous when the tool is run into
19 the well as it, rather than the barrier at the top of the
20 tool would push the majority of the grease and other
21 debris, preventing a build up of such debris around the
22 outside of the tool that may serve to at least partially
23 clog the outside of the filter. A wiping or other
24 cleaning means located at or toward the lower end of the
25 tool would cause the resultant dislodged debris to be
26 suspended in the well fluid and then flow back up the on
27 or more flow paths in the tool, enabling it to be readily
28 filtered as the tool is pulled out.

29

30 Although the example embodiments described above have
31 been intended for running on pipe string, tools
32 incorporating the invention may be readily designed to
33 enable their use on coiled tubing or wireline. As the
34 tools thus far described filter the well fluid on pulling

1 out of the well and not when running in the well there is
2 typically less resistance to movement of the tool in a
3 down-hole direction than in the up-hole direction. It
4 becomes feasible therefore to cater for operations on
5 coiled tubing or wireline where, particularly with the
6 latter, the ability to "push" the tool is limited.

7

8 It would be advantageous in respect of wireline
9 operations, for example, to associate a charging means
10 with a resilient barrier, whereby when the tool is run in
11 the well the barrier is not charged and there is
12 negligible or no contact of the barrier with the well
13 bore tubular, but when the tool is pulled out of the well
14 the barrier is charged by the pressure of the fluid on
15 the up-hole side of the barrier so that the barrier
16 forcibly acts against the tubular and performs a desired
17 wiping function.

18

19 As indicated above, the present invention also finds
20 application in well completions. For example the
21 embodiments illustrated in Figures 6 to 8 herein serve to
22 trap debris as the tools are lowered into the well.

23

24 The tool 50 comprises a body 51 having at least 2 by-pass
25 flow paths 59 formed partially therein. The flow paths
26 incorporate valves 57 and 58 for controlling the
27 direction of flow through the body 51.

28

29 Flow path 69a is adapted to allow the flow of well fluid
30 in a relative upward direction and communicates with a
31 filter means 63. Flow path 69b allows for fluid to flow
32 through the body 61 in a relative downward direction.
33 Thus, as the tool 60 is lowered into a well, undesirable
34 debris is collected in the debris chamber 62. When and

1 if the tool 60 is retracted from the well, fluid may pass
2 through the tool 60 via the flow path 69b.

3

4 The tool 60 also includes a cup seal 66 that engages the
5 casing wall 64. The cup 66 while acting to divert the
6 flow of well fluid through the paths 69, may also be used
7 as a means for wiping the casing wall. Alternatively,
8 scraper blades may be mounted on the outer surface of the
9 cup 66, and the cup may scrape (rather than wipe) the
10 casing. The cup 66 is attached to the body 61 by a shear
11 pin 65 that fails in the event, for example, that passage
12 of fluid through the path 69a becomes obstructed
13 sufficiently to cause a predetermined build up of
14 pressure under the cup 66.

15

16 Turning now to Figure 7, a yet further embodiment of a
17 tool 70 is illustrated. The tool 70 incorporates
18 detachable retaining members 71 that are formed with an
19 annular recess 72 in which is located a cylindrical
20 filter 73. In the upper retaining means 71 there is
21 provided a rupture disc 74 that again is designed to fail
22 under a predetermined load, thereby providing an
23 emergency bypass flow path which avoids the need for
24 fluid passing the tool to pass through the filter 73.

25

26 In the lower retaining means 71 a barrier 75 is provided
27 for the purpose of reducing or negating fluid by-pass
28 between the exterior of the tool 70 and the casing or
29 liner wall (not shown).

30

31 In the example embodiment illustrated the retaining means
32 71 are attached to the mandrel of the tool body via
33 bearings. This allows relative rotation between the

1 mandrel and the retaining means 71 having the effect of
2 mitigating wear of the wiper 75 or casing wall.

3
4 In use, as the tool 70 is lowered into the well, fluid
5 flows up the path 78 and any debris in the fluid collects
6 in the chamber 79. If the filter 73 becomes too blocked
7 the rupture disc 74 opens the emergency by-pass flow path
8 90. The tool 70 may be kept down-hole during completion.
9 However, if and when it is sought to retract the tool 70
10 from the well it is possible to first pressure up above
11 the rupture disc 74 again to open flow path 90 (which
12 communicates with path 78), thereby creating a by-pass
13 flow path enabling the safe retraction of the tool.

14
15 A final and preferred example embodiment for use in
16 filtering well fluid, particularly in well bore
17 completions, is illustrated in Figure 8.

18
19 The tool, generally referenced 80, has a body 81 defining
20 a central bore 82 and one or more flow paths 83. A screen
21 84 for filtering well fluid is held by upper 85 and lower
22 86 retaining assemblies. The lower filter retaining
23 assembly 86 also functions as an upper retaining assembly
24 in relation to a barrier 87, that wipes the well tubular
25 upon movement of the tool 80 and prevents bypass of fluid
26 outside of the tool 80 at that point.

27
28 In likeness to the embodiment of Figure 7 a rupture disc
29 88 is formed in the upper filter retaining assembly 85 to
30 enable emergency bypass when the screen 84 becomes
31 blocked.

32
33 While well cleanup applications have been described by
34 way of example, it should be understood that the present

1 invention is not limited to such tools or such
2 applications. For example, the invention could be
3 applied to pipeline pigs.

4

5 Further modifications and improvements may be
6 incorporated without departing from the scope of the
7 invention herein intended.

1 CLAIMS:

2

3 1. A down-hole tool for collecting debris particles in a
4 well bore, the tool comprising a body connectable in
5 a work string, diversion means for diverting through
6 the tool body well fluid passing the tool, and a
7 filtration means for filtering debris particles from
8 at least some of the well fluid.

9

10 2. A tool as claimed in Claim 1 comprising a barrier
11 dimensioned relative to a casing or liner in the well
12 bore in a manner that permits negligible by-pass of
13 fluid outside the tool body.

14

15 3. A tool as claimed in Claim 2 wherein the diversion
16 means comprises the barrier and one or more flow
17 paths that direct fluid passing through the tool body
18 to the filtration means.

19

20 4. A tool as claimed in any one of the preceding Claims
21 having a plurality of flow paths in the tool body,
22 wherein the flow paths are associated with respective
23 one-way valves, whereby when the fluid passes through
24 the tool body in a first relative direction it does
25 so through a first set of the flow paths having one
26 way valves that so permit, and when the fluid passes
27 through the tool body in a second and opposite
28 relative direction it does so through a second set of
29 the flow paths having one way valves that so permit,
30 but wherein only one of the first and second set of
31 flow paths is adapted to divert the fluid through the
32 filtration means.

33

1 5. A tool as claimed in Claim 4 wherein each valve means
2 comprise of a ball and ball seat, the balls being
3 moveable within respective flow paths under the
4 influence of fluid pressure, wherein the ball seats
5 are formed by a restriction in the cross-sectional
6 area of the flow paths and wherein the balls are
7 sized to land on the ball seats, thereby blocking the
8 further passage of fluid in a particular direction in
9 the respective flow path.

10

11 6. A tool as claimed in any one of Claims 2 to 5 wherein
12 the barrier is formed as a separate component from
13 the tool body, the barrier being connectable to the
14 body so as to permit relative rotation between the
15 tool body and the barrier.

16

17 7. A tool as claimed in any one of Claims 2 to 6 wherein
18 the barrier is resilient and sized such that in use
19 it is radially compressed by the well bore tubular.

20

21 8. A tool as claimed in any one of Claims 2 to 7 wherein
22 the barrier performs a cleaning operation in use by
23 the wiping of the well bore tubular as the tool moves
24 up or down the well bore.

25

26 9. A tool as claimed in any one of Claims 1 to 8 having
27 one or more cleaning members for cleaning the well
28 bore tubular as the tool moves up or down the well
29 bore.

30

31 10. A tool as claimed in Claim 9 wherein there is
32 provided a cleaning member toward each end thereof,
33 and wherein the cleaning members are resilient and
34 adapted to wipe the well bore tubular.

- 1
2 11. A tool as claimed in any one of Claims 1 to 10
3 wherein the filtration means comprises a wire screen.
4
- 5 12. A tool as claimed in any one of Claims 1 to 11
6 wherein the filtration means comprises a plurality of
7 filters provided in series, wherein at least two of
8 the filters are of differing permeability.
9
- 10 13. A tool as claimed in any one of Claims 1 to 12
11 further comprising a trap for the collection of
12 debris particles.
13
- 14 14. A tool as claimed in Claim 13 wherein the trap is
15 formed in the tool body upstream of the filter means.
16
- 17 15. A tool as claimed in any one of Claims 1 to 14
18 further comprising an emergency by-pass that is
19 obstructed in normal use of the tool but opens upon
20 the occurrence of predetermined conditions, wherein
21 the emergency by-pass enables fluid flowing past the
22 tool to by-pass the filter means.
23
- 24 16. A tool as claimed in Claim 15 comprising a barrier
25 dimensioned relative to a casing or liner in the well
26 bore in a manner that permits negligible by-pass of
27 fluid outside the tool body, wherein the emergency
28 by-pass is caused by the displacement of the barrier
29 relative to the tool body to a position where it no
30 longer diverts substantially all of the fluid passing
31 the tool through the tool body.
32
- 33 17. A tool as claimed in Claim 15 wherein the tool body
34 has radial outlets communicating with one or more

1 flow paths, the outlets being maintained in a closed
2 state by an obstructing member in normal use, but
3 being openable by movement of the obstructing member
4 to create the emergency by-pass.
5

6 18. A tool as claimed in Claim 15 comprising a barrier
7 dimensioned relative to casing or other tubulars in
8 the well bore in a manner that permits negligible by-
9 pass of fluid outside the tool body, wherein the
10 emergency by-pass is created by the rupture of a
11 member in the barrier.
12

13 19. A tool as claimed in any one of Claims 1 to 18
14 wherein the work string is in the form of wireline.
15

16 20. A tool as claimed in any one of Claims 1 to 18
17 wherein the tool body has an internal bore running
18 axially there-through and which communicates with a
19 circulation path in the work string.
20

21 21. A down-hole tool comprising means for wiping well
22 casing or other tubulars, a trap for collecting
23 debris or other matter and a filter for filtering
24 well fluid while the tool is down-hole.
25

26 22. A down-hole tool comprising a body connectable in a
27 work string and a filter for filtering well fluid
28 passing the tool while down-hole, wherein the body
29 defines a circulation path communicating with a
30 circulation path in the work string for enabling
31 circulation of fluid through the tool.
32

33 23. A down-hole tool as claimed in Claim 22, wherein the
34 tool body defines one or more flow paths for

1 providing passage of fluid between the work string
2 and the well bore casing or other tubular, wherein at
3 least some of the flow paths are associated with
4 respective filtration means for filtering fluid as it
5 passes the tool.

6

7 24. A method of cleaning a down-hole environment
8 comprising the steps of:

9

10 a) running a tool heading a filtration means on a
11 work string down-hole;

12

13 b) creating relative movement between the down-hole
14 movement and the tool; and

15

16 c) actively guiding at least some of the fluid
17 passing the tool through the filtration means.

18

19 25. A method as claimed in Claim 24 further including the
20 process of trapping filtered debris upstream of the
21 filtration means.

22

23 26. A method as claimed in Claim 24 or 25 wherein the
24 relative movement between the fluid and the tool is
25 created by the pulling up of the work string in the
26 well.

27

28 27. A method as claimed in Claim 26 further including the
29 step of mechanically cleaning the casing or liner in
30 the well bore as the tool is raised with the work
31 string.

32

33 28. A method as claimed in any one of Claims 24 to 28
34 wherein the cleaning of the casing or liner involves

1 the wiping, brushing or scraping of the casing or
2 liner wall.

3

4 29. A method as claimed in any one of Claims 24 to 28
5 wherein the relative movement between the fluid and
6 the tool is created by the lowering of the work
7 string in the well.

8

9 30. A method as claimed in Claim 29 further including the
10 step of mechanically cleaning a casing or liner in
11 the well bore as the tool is lowered.

12

13 31. A method as claimed in Claim 30 wherein the cleaning
14 of the casing or liner involves the wiping, brushing
15 or scraping of the liner wall.

16

17 32. A method as claimed in Claim 31 wherein the work
18 string is wire line or coil tubing.

19

20 33. A method as claimed in any one of Claims 24 to 32
21 wherein the relative movement between the fluid and
22 the tool is created by circulating or reverse
23 circulating fluid in the well.

24

25 34. A method as claimed in any one of Claims 24 to 33
26 wherein the work string is a pipe string.

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.